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(54) IMAGE RECORDING DEVICE, AND IMAGE RECORDING METHOD

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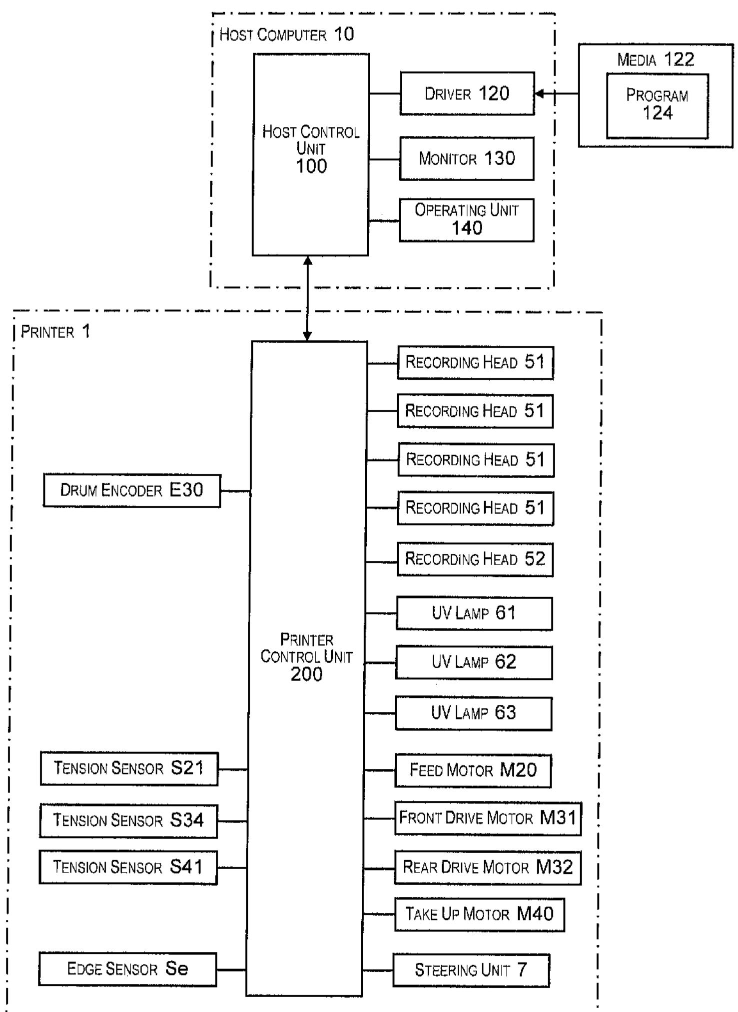
(57) ABSTRACT

An image recording device comprising: a transport unit that transports a recording medium from a first drive roller to a second drive roller by rotating a first drive roller and a second drive roller across which a recording medium is stretched, a support member that supports the recording medium between the first drive roller and the second drive roller, a recording unit that ejects liquid on the recording medium supported on the support member and records an image, a detection unit that detects tension of the recording medium, and a control unit that gives tension to the recording medium by controlling the torque of the first drive roller based on the recording medium tension detected by the detection unit.



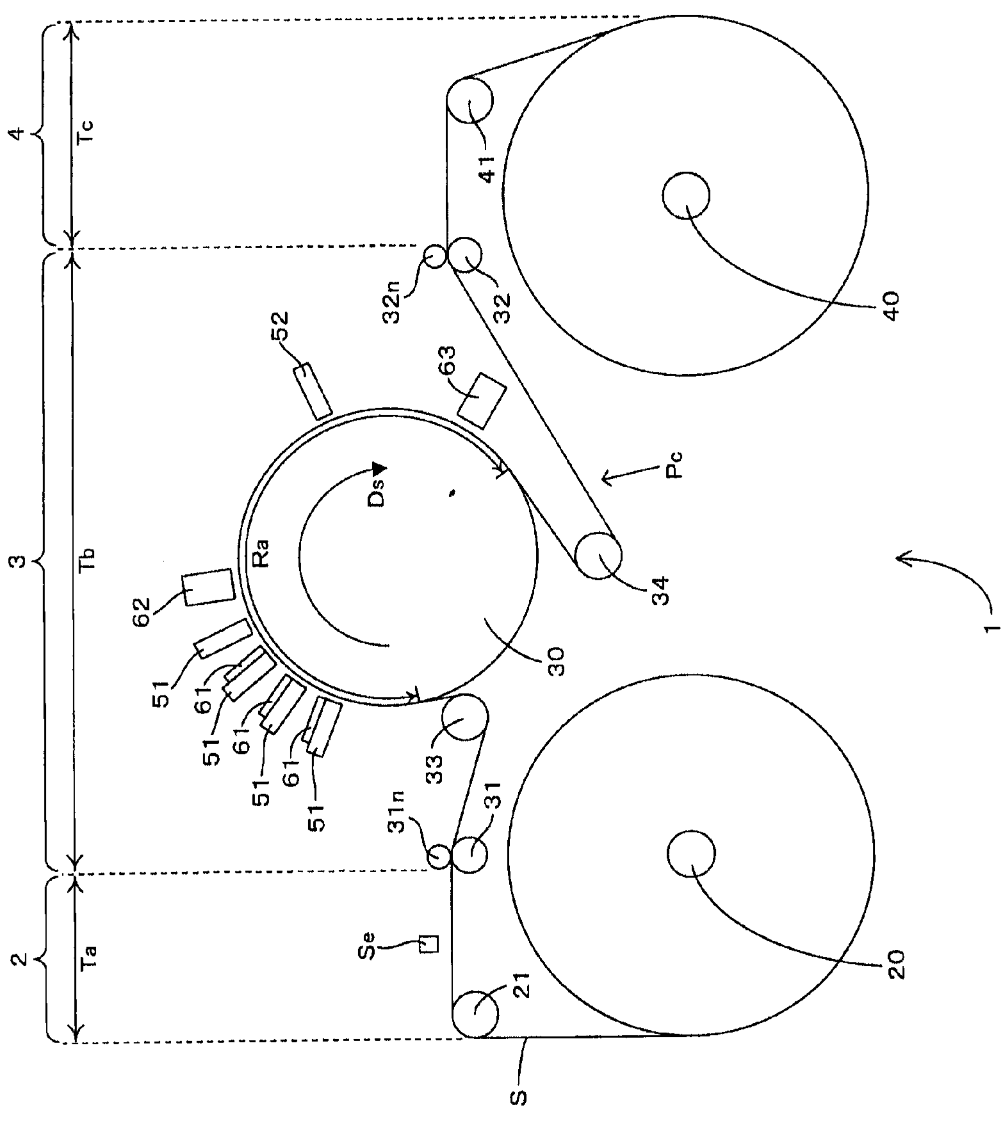

2
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Fig. 1

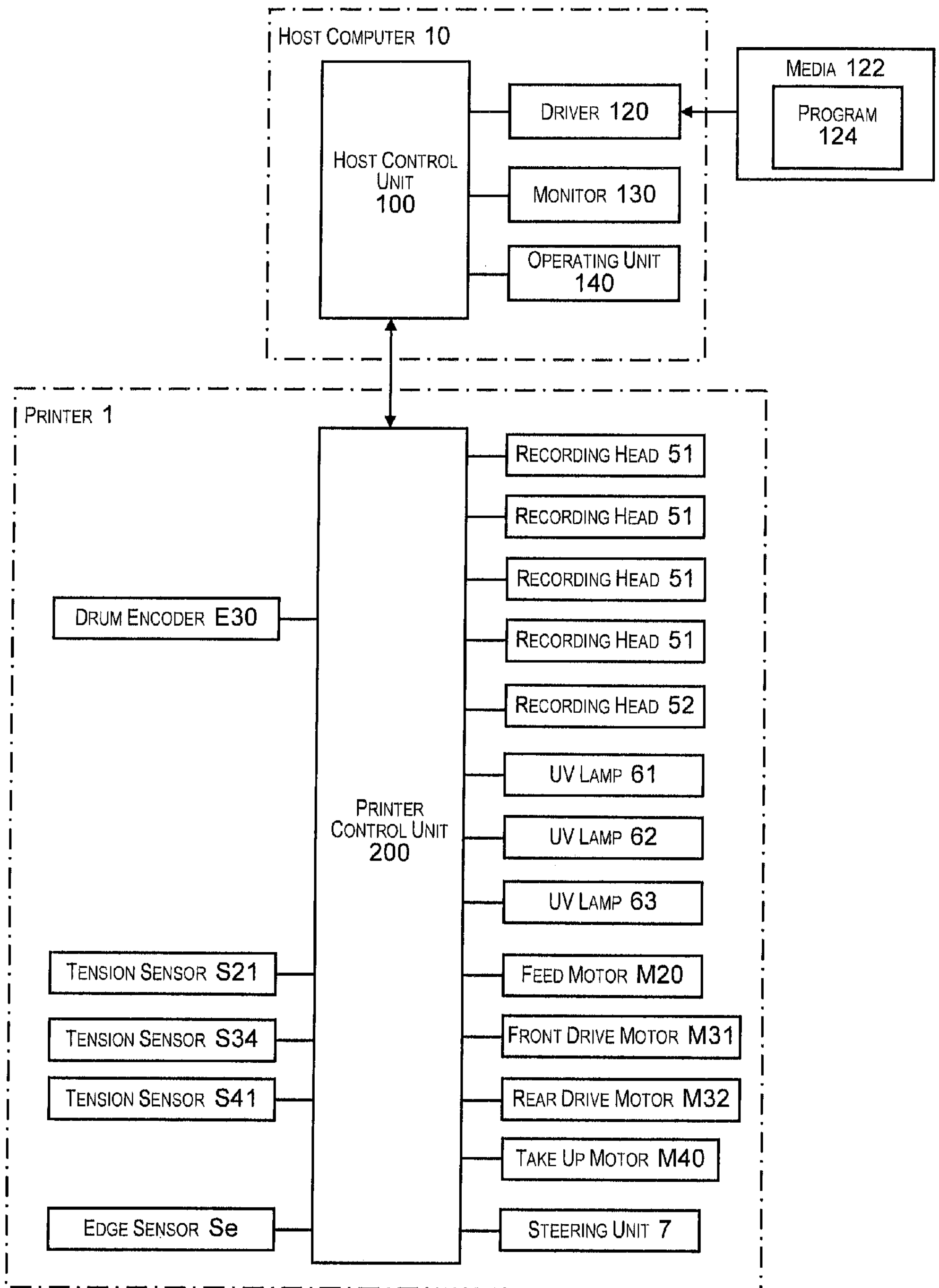
HOST COMPUTER 10
HOST CONTROL UNIT 100
DRIVER 120
MONITOR 130
OPERATING UNIT 140
MEDIA 122
PROGRAM 124
PRINTER 1
PRINTER CONTROL UNIT 200
DRUM ENCODER E30
TENSION SENSOR S21
TENSION SENSOR S34
TENSION SENSOR S41
EDGE SENSOR Se
RECORDING HEAD 51
RECORDING HEAD 51
RECORDING HEAD 51
RECORDING HEAD 51
RECORDING HEAD 52
UV LAMP 61
UV LAMP 62
UV LAMP 63
FEED MOTOR M20
FRONT DRIVE MOTOR M31
REAR DRIVE MOTOR M32
TAKE UP MOTOR M40
STEERING UNIT 7

Fig. 2

IMAGE RECORDING DEVICE, AND IMAGE RECORDING METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to Japanese Patent Application No. 2011-264590 filed on Dec. 2, 2011. The entire disclosure of Japanese Patent Application No. 2011-264590 is hereby incorporated herein by reference.

BACKGROUND

[0002] 1. Technical Field

[0003] This invention relates to technology for recording images on a recording medium using a recording unit while transporting the recording medium.

[0004] 2. Background Technology

[0005] Noted in Patent Document 1 is a recording device for spraying ink from a printing unit arranged between a paper transport unit and a paper puller unit to record an image on a continuous form transported from the paper transport unit to the paper puller unit. Both the paper transport unit and the paper puller unit are equipped with a drive roller (transport roll **9**_a_, **13**_a_) connected to a motor, and when each drive roller receives drive force from the motor and rotates, the recording medium (continuous form) stretched across these drive rollers is transported along the transport path. At this time, the paper feed volume of the downstream side drive roller is set to be slightly greater than the paper feed volume of the upstream side drive roller in the transport path. In other words, the circumferential velocity of the downstream side drive roller is slightly faster than the circumferential velocity of the upstream side drive roller, and by pulling the recording medium using the downstream side drive roller, tension is given to the recording medium.

[0006] Japanese Laid-open Patent Publication No. H10-086472 (Patent Document 1) is an example of the related art.

SUMMARY

Problems to be Solved by the Invention

[0007] However, as with the recording device noted above, with a constitution which gives tension to the recording medium by providing a velocity difference to the circumferential velocity of the two drive rollers, there were cases when slipping occurred between the drive roller and the recording medium, and the recording medium tension fluctuated. As a result, there was the risk that it would not be possible to do stable transporting of the recording medium, that the ink impact position on the recording medium would fluctuate, and that it would not be possible to record the image on the recording medium with sufficient positional precision.

[0008] The present invention was created considering the problems noted above, and an advantage is to provide technology capable of suppressing the fluctuation of the tension of the recording medium, and recording an image on a recording medium with high positional precision.

Means Used to Solve the Above-Mentioned Problems

[0009] To achieve the advantage noted above, the image recording device of the invention is equipped with a transport unit that, by rotating a first drive roller and a second drive roller across which a recording medium is stretched, transports the recording medium from the first drive roller to the second drive roller, a support member that supports the recording medium between the first drive roller and the second drive roller, a recording unit that ejects a liquid on a recording medium supported on the support member and records an image, a detection unit that detects the tension of the recording medium, and a control unit that gives tension to the recording medium by controlling the torque of the first drive roller based on the tension of the recording medium detected by the detection unit.

[0010] To achieve the advantage noted above, the image recording method of the invention is an image recording method that, by rotating the first drive roller and the second drive roller across which the recording medium is stretched, supports on a support member the recording medium transported from the first drive roller to the second drive roller, and also ejects liquid on the recording medium supported on the support member to record an image, and is characterized in that tension is given to the recording medium by controlling the torque of the first drive roller based on the detection results of the tension of the recording medium.

[0011] The invention constituted in this way (image recording device, image recording method) transports a recording medium from the first drive roller to the second drive roller by rotating the first drive roller and the second drive roller across which the recording medium is stretched. Then, by controlling the torque of the first drive roller, tension is given to the recording medium on which the recording unit is performing image recording. In other words, rather than giving a difference in the circumferential velocity of the two drive rollers that transport the recording medium, tension is given to the recording medium by controlling the torque of the first drive roller. With this kind of constitution, the occurrence of slipping between the drive roller and the recording medium like that described above is suppressed, and it is possible to suppress fluctuation of the tension of the recording medium. As a result, stable transport of the recording medium is realized, making it possible to record an image on the recording medium with high positional precision.

[0012] It is also possible to constitute the image recording device such that the control unit controls the speed of the second drive roller and rotates the second drive roller at a designated speed. With this kind of constitution, it is possible to make the upstream side recording medium tension from the second drive roller in the recording medium transport direction independent from the downstream side recording medium tension. To say this another way, the second drive roller downstream side tension does not affect the second drive roller upstream side tension. Therefore, even if the tension fluctuates on the second drive roller downstream aide, it is possible to perform image recording on the recording medium with stable tension on the second drive roller upstream side, which is preferable.

[0013] In light of this, it is also possible to constitute the image recording device further equipped with a take up roller that takes up the recording medium which is fed from the second roller, and by controlling the torque of the take up roller, the control unit reduces the tension of the recording medium when taken up on the take up roller in accordance with the increase in volume of the recording medium taken up on the take up roller. With this kind of constitution, it is possible to reduce the recording medium tension when taken up on the take up roller in accordance with the increase in the volume of the recording medium taken up on the take up roller without affecting the tension of the recording medium undergoing image recording further upstream from the second drive roller. Then, by reducing the recording medium tension when it is taken up on the take up roller in this way, it is possible to control so that there is no damage to the recording medium by there being excess pressure of the recording medium near the take up roller in accordance with an increase in the volume of the recording medium taken up on the take up roller.

[0014] However, with a constitution for which liquid is ejected on a recording medium to record images, there are cases when a difference in tension (tension distribution) occurs between the liquid adhered parts on the recording medium and the other parts. However, by supporting the recording medium with a support member, it is possible to make the overall tension of the recording medium stable regardless of this kind of microscopic tension distribution. Therefore, if constituted so that the image is recorded on the recording medium that is supported on the support member, it is possible to do suitable image recording without being affected by microscopic tension distribution.

[0015] Meanwhile, when the recording medium separates from the support member and is able to expand and contract freely, there are cases when this microscopic tension distribution causes tension fluctuation of the overall recording medium. In other words, the tension distribution that occurs on the recording medium sometimes fluctuates the tension of the recording medium moving away from the support member toward the second drive roller. This tension fluctuation occurs on the recording medium for which image recording has already been done, so it basically does not affect the image recording. However, when the detection unit detects this tension fluctuation and changes the torque of the first drive roller, it is conceivable that the tension of the recording medium on the support member will fluctuate.

[0016] In light of that, it is also possible to constitute the image recording device such that the detection unit detects the recording medium tension between the first drive roller and the support member. With this kind of constitution, it is possible to suitably suppress tension fluctuation of the recording medium on the support member regardless of the tension of the recording medium after separating from the support member. Therefore, stable transport of the recording medium is realized, and this is advantageous in terms of recording images on the recording medium with high positional precision.

[0017] It is particularly preferable to use a constitution like that noted above for an image recording device for which the recording unit ejects as the liquid a photo curing ink that is cured by light, and the image recording device is further equipped with a light radiating unit that radiates light on the ink ejected onto the recording medium from the recording unit. In other words, this kind of photo curing ink generates heat along with the curing reaction, and also generates heat by absorbing light. Therefore, on the recording medium, the temperature of the ink adhered part is higher than the temperature of the other parts. Thus, there is a difference in the tension between the high temperature parts and the low temperature parts, the kind of tension distribution described above occurs on the recording medium, and fluctuation occurs easily in the tension of the recording medium from the support member to the second drive roller. In light of that, it is preferable to use a constitution like that noted above, and to suitably suppress tension fluctuation of the recording medium on the support member regardless of the tension of the recording medium after it separates from the support member.

[0018] It is also possible to further equip a driven roller that winds the recording medium that moves from the first drive roller toward the support member, and to constitute the image recording device such that the detection unit is provided on the driven roller. A constitution for which the tension of the recording medium is detected by the detection unit provided in the driven roller in this way is preferable because it is able to detect the tension of the recording medium while suppressing the effect of the tension detection operation on the transport of the recording medium.

[0019] It is also possible to have a constitution for which the support member is a drum that winds the recording medium and rotates by receiving the frictional force with the recording medium transported by the transport unit. With this kind of constitution, the drum that supports the recording medium rotates following the transported recording medium. Therefore, it is beneficial for suppressing the occurrence of slipping between the recording medium and the drum, and for stabilizing the tension of the recording medium.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Referring now to the attached drawings which form a part of this original disclosure:

[0021] FIG. **1** is a drawing schematically showing an example of the constitution of a device equipped with a printer to which the invention can be applied; and

[0022] FIG. **2** is a drawing schematically showing the electrical configuration for controlling the printer shown in FIG. **1**.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0023] FIG. **1** is a front view schematically showing an example of the constitution of a device equipped with a printer to which the invention can be applied. As shown in FIG. **1**, with a printer **1**, one sheet S (web), for which both ends are wound into a roll on a feed shaft **20** and a take up shaft **40**, is stretched between the feed shaft **20** and the take up shaft **40**, and the sheet S is transported from the feed shaft **20** to the take up shaft **40** along the path Pc on which it is stretched in this way. Then, with the printer **1**, an image is recorded on this sheet S that is transported along the transport path Pc. The types of sheet S are roughly divided into paper and film. Specific examples include high quality paper, cast paper, art paper, coated paper and the like for the paper type, and synthetic paper, PET (Polyethylene terephthalate), PP (polypropylene) and the like for the film type. Schematically, the printer **1** is equipped with a feed unit **2** that feeds the sheet S from the feed shaft **20**, a process unit **3** that records images on the sheet S fed from the feed unit **2**, and a take up unit **4** that takes up the sheet S on which the image is recorded by the process unit **3** onto the take up shaft **40**. With the description below, of both surfaces of sheet S, while the surface on which the image is recorded is called the front surface, the reverse side surface is called the back surface.

[0024] The feed unit **2** has a feed shaft **20** onto which an end of the sheet S is wound, and a driven roller **21** onto which the sheet S pulled from the feed shaft **20** is wound. The feed shaft **20** is in a state for which the front surface of the sheet S faces the outside, and an end of the sheet S is wound on and supported. Then, by the feed shaft **20** rotating clockwise in

FIG. **1**, the sheet S that was wound on the feed shaft **20** is fed to the process unit **3** via the driven roller **21**. Incidentally, the sheet S is wound on the feed shaft **20** via a freely detachable core tube (not illustrated) on the feed shaft **20**. Therefore, when the sheet S of the feed shaft **20** is used up, a new core tube on which a rolled sheet S is wound is mounted on the feed shaft **20**, and it is possible to replace the sheet S of the feed shaft **20**.

[0025] The process unit **3** is an item that performs processing as appropriate using each functional unit **51**, **52**, **61**, **62**, and **63** arranged along the outer circumference surface of a platen drum **30** while supporting the sheet S fed from the feed shaft **2** on the platen drum **30** to record an image on the sheet S. With this process unit **3**, a front drive roller **31** and a rear drive roller **32** are provided at both sides of the platen drum **30**, and the sheet S fed from the front drive roller **31** to the rear drive roller **32** is supported on the platen drum **30** and undergoes image recording.

[0026] The front drive roller **31** has a plurality of tiny projections formed by thermal spraying on the outer circumference surface, and the sheet S fed from the feed unit **2** is wound from the rear surface side. Then, by the front drive roller **31** rotating clockwise in FIG. **1**, the sheet S fed from the feed unit **2** is fed to the downstream side of the transport path. A nip roller **31*n*** is provided on the front drive roller **31**. This nip roller **31*n*** abuts the front surface of the sheet S in a state biased to the front drive roller **31** side, and the sheet S is sandwiched between it and the front drive roller **31**. By doing this, frictional force between the front drive roller **31** and the sheet S is ensured, and it is possible to reliably transport the sheet S using the front drive roller **31**.

[0027] The platen drum **30** is a cylindrical shaped drum supported to be able to rotate freely by a support mechanism that is not illustrated, and the sheet S transported from the front drive roller **31** to the rear drive roller **32** is wound from the rear surface side. This platen drum **30** is an item that supports the sheet S from the rear surface side while receiving the frictional force with the sheet S and being driven and rotated in the sheet S transport direction Ds. Incidentally, with the process unit **3**, driven rollers **33** and **34** that turn back the sheet S are provided at both sides of the wind up unit to the platen drum **30**. Of these, the driven roller **33** winds the front surface of the sheet S between the front drive roller **31** and the platen drum **30**, and turns back the sheet S. Meanwhile, the driven roller **34** winds the front surface of the sheet S between the platen drum **30** and the rear drive roller **32** and turns back the sheet S. In this way, by turning back the sheet S respectively in the upstream and downstream side of the transport direction Ds in relation to the platen drum **30**, it is possible to ensure a long winding part of the sheet S to the platen drum **30**.

[0028] The rear drive roller **32** has a plurality of tiny projections formed by thermal spraying on the outer circumference surface, and the sheet S transported from the platen drum **30** via the driven roller **34** is wound from the rear surface side. Then, by rotating the rear drive roller **32** in the clockwise direction in FIG. **1**, the sheet S is transported to the take up unit **4**. A nip roller **32*n*** is provided on the rear drive roller **32**. This nip roller **32*n*** abuts the front surface of the sheet S in a state biased toward the rear drive roller **32** side, and the sheet S is sandwiched between it and the rear drive roller **32**. By doing this, frictional force is ensured between the rear drive roller **32** and the sheet S, and it is possible to reliably perform transport of the sheet S by the rear drive roller **32**.

[0029] In this way, the sheet S transported from the front drive roller **31** to the rear drive roller **32** is supported on the outer circumference surface of the platen drum **30**. Then, with the process unit **3**, to record color images on the front surface of the sheet S supported on the platen drum **30**, a plurality of recording heads **51** corresponding to mutually different colors are provided. In specific terms, four recording heads **51** corresponding to yellow, cyan, magenta, and black are aligned in this color sequence in the transport direction Ds. Each recording head **51** faces opposite a slight clearance opened in relation to the front surface of the sheet S wound on the platen drum **30**, and ink of the corresponding color is ejected using the inkjet method. Then, by each recording head **51** ejecting ink on the sheet S transported in the transport direction Ds, a color image is formed on the front surface of the sheet S.

[0030] Incidentally, as ink, a UV (ultraviolet) ink (photo curing ink) that is cured by the irradiation of ultraviolet rays (light) is used. In light of that, with the process unit **3**, to cure the ink and fix it on the sheet S, UV lamps **61** and **62** (light radiating units) are provided. This ink curing is executed divided into two stages, preliminary curing and main curing. In each space between the plurality of recording heads **51** is arranged a UV lamp **61** for preliminary curing. In other words, by radiating weak ultraviolet waves, the UV lamps **61** cure (preliminary curing) the ink to the degree that the ink shape will not break down, but do not completely cure the ink. Meanwhile, at the downstream side in the transport direction Ds to the plurality of recording heads **51**, the UV lamp **62** for main curing is provided. In other words, the UV lamp **62**, by radiating stronger ultraviolet rays than those of the UV lamps **61**, does complete curing (main curing) of the ink. By doing preliminary curing and main curing in this way, it is possible to fix the color image formed by the plurality of recording heads **51** on the front surface of the sheet S.

[0031] Furthermore, a recording head **52** is provided at the downstream side of the transport direction Ds in relation to the UV lamp **62**. This recording head **52** faces opposite a slight clearance left open in relation to the front surface of the sheet S wound on the platen drum **30**, and ejects transparent UV ink on the front surface of the sheet S using the inkjet method. In other words, transparent ink is further ejected on the color image formed by the four colors of recording heads **51**. Also, a UV lamp **63** is provided downstream in the transport direction Ds in relation to the recording head **52**. This UV lamp **63** radiates strong ultraviolet rays to completely cure (main cure) the transparent ink ejected by the recording head **52**. By doing this, it is possible to fix the transparent ink to the front surface of the sheet S.

[0032] In this way, with the process unit **3**, the platen drum **30** winds and supports the sheet S on its outer circumference surface. Then, in relation to the winding part Ra of the platen drum **30** which winds the sheet S, each functional unit of the recording heads **51** and **52** and the UV lamps **61**, **62**, and **63** face opposite sandwiching the sheet S, and ejecting of ink on the front surface of the sheet S wound on the winding part Ra and curing are executed as appropriate. By doing this, a color image coated with transparent ink is formed. Then, the sheet S on which this color image is formed is transported to the take up unit **4** by the rear drive roller **32**.

[0033] The take up unit **4**, in addition to the take up shaft **40** on which an end of the sheet S is wound, also has a driven roller **41** on which the sheet S is wound from the rear surface side between the take up shaft **40** and the rear drive roller **32**.

The take up shaft **40** winds and supports an end of the sheet S in a state with the front surface of the sheet S facing the outside. In other words, when the take up shaft **40** is rotated in the clockwise direction in FIG. **1**, the sheet S transported from the rear drive roller **32** is taken up on the take up shaft **40** via the driven roller **41**. Incidentally, the sheet S is taken up on the take up shaft **40** via the freely detachable core tube (not illustrated) on the take up shaft **40**. Therefore, when the sheet S taken up on the take up shaft **40** is full, it is possible to remove the sheet S for each core tube.

[0034] The above is a summary of the device constitution of the printer **1**. Following, we will describe the electrical configuration for controlling the printer **1**. FIG. **2** is a block diagram schematically showing the electrical configuration for controlling the printer shown in FIG. **1**. The operation of the printer **1** described above is controlled by the host computer **10** shown in FIG. **2**. With the host computer **10**, the host control unit **100** that presides over the control operations is constituted by a CPU (Central Processing Unit) and memory. Also, a driver **120** is provided on the host computer **10**, and this driver **120** reads a program **124** from media **122**. As the media **122**, it is possible to use various items such as a CD (Compact Disk), a DVD (Digital Versatile Disk), USB (Universal Serial Bus) memory or the like. Then, the host control unit **100** performs control of each part of the host computer **10** or control of the operation of the printer **1** based on the program **124** read from the media **122**.

[0035] Furthermore, as the interface for the worker with the host computer **10**, a monitor **130** constituted by a liquid crystal display or the like and an operating unit **140** constituted by a keyboard, mouse or the like are provided. In addition to the printed subject image, a menu screen is also displayed on the monitor **130**. Therefore, by the worker operating the operating unit **140** while confirming the monitor **130**, it is possible to open the print setting screen from the menu screen, and to set various printing conditions such as the type of printing medium, the printing medium size, the print quality and the like. Various modifications of the specific configuration of the interface with the worker are possible, and for example a touch panel display can be used as the monitor **130**, and the operating unit **140** can be constituted using the touch panel of this monitor **130**.

[0036] Meanwhile, with the printer **1**, a printer control unit **200** is provided that controls each part of the printer **1** according to instructions from the host computer **10**. Then, the recording heads, the UV lamps, and each part of the sheet transporting device are controlled by the printer control unit **200**. The details of the control of the printer control unit **200** on each of these device parts are as follows.

[0037] The printer control unit **200** controls the ink ejection timing of each recording head **51** that forms the color image according to the transporting of the sheet S. In specific terms, the control of this ink ejection timing is executed based on the output (detection value) of a drum encoder E**30** that is attached to the rotation shaft of the platen drum **30** and detects the rotation position of the platen drum **30**. In other words, the platen drum **30** does driven rotation according to the transport of the sheet S, so if the output of the drum encoder E**30** that detects the rotation position of the platen drum **30** is referenced, it is possible to find out the transport position of the sheet S. In light of this, the printer control unit **200** generates a pts (print timing signal) signal from the output of the drum encoder E**30**, and by controlling the ink ejection timing of each recording head **51** based on this pts signal, has the ink ejected by each recording head **51** impact the target position of the transported sheet S to form a color image.

[0038] Also, the timing of ejecting transparent ink by the recording head **52** is similarly controlled by the printer control unit **200** based on the output of the drum encoder E**30**. By doing this, it is possible to appropriately eject transparent ink on the color image formed by the plurality of recording heads **51**. Furthermore, the on and off timing and the radiated light volume of the UV lamps **61**, **62**, and **63** are also controlled by the printer control unit **200**.

[0039] Also, the printer control unit **200** is in charge of the function of controlling the transport of the sheet S described in detail using FIG. **1**. In other words, of the members constituting the sheet transport system, the feed shaft **20**, the front drive roller **31**, the rear drive roller **32**, and the take up shaft **40** respectively have a motor connected to them. Then, the printer control unit **200** controls the speed and torque of each motor while rotating these motors, and controls the transport of the sheet S. The details of this sheet S transport control are as follows.

[0040] The printer control unit **200** rotates a feed motor M**20** for driving the feed shaft **20**, and supplies the sheet S from the feed shaft **20** to the front drive roller **31**. At this time, the printer control unit **200** controls the torque of the feed motor M**20**, and adjusts the tension of the sheet S from the feed shaft **20** to the front drive roller **31** (feed tension Ta). In other words, a tension sensor S**21** for detecting the feed tension Ta is attached to the driven roller **21** arranged between the feed shaft **20** and the front drive roller **31**. This tension sensor S**21** can be constituted by load cells for detecting the force received from the sheet S, for example. Then, the printer control unit **200** does feedback control of the torque of the feed motor M**20** based on the detection results of the tension sensor S**21**, and adjusts the feed tension Ta of the sheet S.

[0041] At this time, the printer control unit **200** feeds the sheet S while adjusting the position in the width direction (orthogonal direction to the paper surface in FIG. **1**) of the sheet S being supplied from the feed shaft **20** to the front drive roller **31**. In other words, a steering unit **7** for which the feed shaft **20** and the driven roller **21** are respectively displaced in the axis direction (in other words, the width direction of the sheet S) is provided on the printer **1**. Also, an edge sensor Se that detects the edge in the sheet S width direction is arranged between the driven roller **21** and the front drive roller **31**. This edge sensor Se can be constituted using a distance sensor such as an ultrasonic sensor, for example. Then, the printer control unit **200** does feedback control of the steering unit **7** based on the detection results of the edge sensor Se and adjusts the position in the sheet S width direction. By doing this, the position in the sheet S width direction is made to be appropriate, and transport failure such as meandering of the sheet S or the like is suppressed.

[0042] Also, the printer control unit **200** rotates a front drive motor M**31** for driving the front drive roller **31** and a rear drive motor M**32** for driving the rear drive roller **32**. By doing this, the sheet S fed from the feed unit **2** passes through the process unit **3**. At this time, while torque control is executed on the front driver motor M**31**, speed control is executed on the rear drive motor M**32**. In other words, the printer control unit **200** adjusts the rotation speed of the rear drive motor M**32** to be constant based on the encoder output of the rear drive motor M**32**. By doing this, the rear drive roller **32** rotates at a constant speed, and the sheet S is transported at a constant speed by the rear drive roller **32**.

[0043] Meanwhile, the printer control unit **200** controls the torque of the front drive motor M**31** and adjusts the tension (process tension Tb) of the sheet S from the front drive roller **31** to the rear drive roller **32**. In other words, a tension sensor S**33** that detects the process tension Tb is attached to the driven roller **33** arranged between the front drive roller **31** and the platen drum **30**. This tension sensor S**33** can be constituted by a load cell for detecting the force received from the sheet S, for example. In this way, using the tension sensor S**33**, the tension of the sheet S moving from the front drive roller **31** toward the platen drum **30** is detected. Then, the printer control unit **200** does feedback control of the torque of the front drive motor M**31** based on the detection results of the tension sensor S**33** and adjusts the sheet S process tension Tb.

[0044] To describe this in detail, the torque of the front drive motor M**31** is controlled so that a force reverse to the transport direction of the sheet S is operated by the front drive roller **31** on the sheet S transported at a constant speed by the rear drive roller **32**. In this way, between the front drive roller **31** and the rear drive roller **32**, the sheet S is pulled by a force according to the torque of the front drive motor M**31**, and the process tension Tb of the sheet S is adjusted to be constant.

[0045] Also, the printer control unit **200** rotates the take up motor M**40** that drives the take up shaft **40**, and the sheet S transported by the rear drive roller **32** is taken up on the take up shaft **40**. At this time, the printer control unit **200** controls the torque of the take up motor M**40**, and adjusts the tension (take up tension Tc) of the sheet S from the rear drive roller **32** to the take up shaft **40**. In other words, a tension sensor S**41** that detects the take up tension Tc is attached to the driven roller **41** arranged between the rear drive roller **32** and the take up shaft **40**. The tension sensor S**41** can be constituted using a load cell that detects the force received from the sheet S, for example. Then, the printer control unit **200** does feedback control of the torque of the take up motor M**40** based on the detection results of the tension sensor S**41** and adjusts the take up tension Tc of the sheet S. In specific terms, the printer control unit **200** reduces the take up tension Tc in accordance with the increase in roll diameter consisting of the sheet S taken up on the take up shaft **40**. By doing this, as the roll diameter increases, it is possible to control so that the pressure of the sheet S does not become excessive near the roll center, and that the sheet S is not damaged.

[0046] As described above, with this embodiment, by rotating the front drive roller **31** and the rear drive roller **32** on which the sheet S is stretched, the sheet S is transported from the front drive roller **31** to the rear drive roller **32**. Then, by controlling the torque of the front drive roller **31**, tension (process tension Tb) is given to the sheet S for which the recording heads **51** and **52** perform image recording. In other words, tension is given to the sheet S by controlling the torque of the front drive roller **31** rather than giving a circumferential velocity difference to the two drive rollers **31** and **32** that transport the sheet S. With this kind of constitution, it is possible to suppress the occurrence of slipping between the drive rollers **31** and **32** and the sheet S like that described above, and to suppress tension fluctuation of the sheet S. As a result, stable transport of the sheet S is realized, and it is possible to record an image on the sheet S with high positional precision.

[0047] Also, with this embodiment, the printer control unit **200** controls the speed of the rear drive roller **32** to rotate the rear drive roller **32** at a designated speed. With this kind of constitution, it is possible to make the sheet S tension (process tension Tb) on the upstream side from the rear drive roller **32** in the sheet S transport direction independent from the downstream side sheet S tension (take up tension Tc). In other words, the take up tension Tc of the rear drive roller **32** downstream side does not affect the process tension Tb of the rear drive roller **32** upstream side. Therefore, even if there is fluctuation of the take up tension Tc at the rear drive roller **32** downstream side, it is possible to perform image recording on the sheet S with stable process tension Tb on the rear drive roller **32** upstream side, and this is preferable.

[0048] In light of that, with this embodiment, by controlling the torque of the take up shaft **40** that takes up the sheet S fed from the rear drive roller **32**, take up tension Tc of the sheet S when it is taken up on the take up shaft **40** is reduced in accordance with an increase in the volume of the sheet S taken up on the take up shaft **40**. With this kind of constitution, it is possible to reduce the tension of the sheet S when taken up on the take up shaft **40** in accordance with an increase in the volume of the sheet S taken up on the take up shaft **40** without having an effect on the process tension Tb of the sheet S undergoing image recording at the upstream side from the rear drive roller **32**. Then, by reducing the tension of the sheet S when it is taken up on the take up shaft **40** in this way, it is possible to control so that the sheet S is not damaged by the pressure of the sheet S near the take up shaft **40** becoming excessive with an increase in the volume of the sheet S taken up on the take up shaft **40**.

[0049] However, with a constitution for which ink is ejected onto the sheet S to record an image, there are cases when a tension difference (tension distribution) occurs between the ink adhered part of the sheet S and the other parts. However, by supporting the sheet S on the platen drum **30**, it is possible to have stable tension overall for the sheet S regardless of this kind of microscopic tension distribution. Therefore, if the constitution is made so that images are recorded on the sheet S supported on the platen drum **30**, it is possible to suitably record images without being affected by the microscopic tension distribution.

[0050] Meanwhile, when the sheet S separates from the platen drum **30** and is able to expand and contract freely, there are cases when this microscopic tension distribution causes tension fluctuation of the overall sheet S. In other words, the tension distribution that occurs on the sheet S sometimes fluctuates the tension of the sheet S moving away from the platen drum **30** (winding part Ra) and toward the rear drive roller **32**. This tension fluctuation occurs on the sheet S for which image recording has already been done, so it basically does not affect the image recording. However, when the tension sensor detects this tension fluctuation and changes the torque of the front drive roller **31**, it is conceivable that the tension of the sheet S on the platen drum **30** will fluctuate.

[0051] In light of that, this embodiment is made to detect the sheet S tension between the front drive roller **31** and the platen drum **30**. With this kind of constitution, it is possible to suitably suppress tension fluctuation of the sheet S on the platen drum **30** regardless of the tension of the sheet S after separating from the platen drum **30**. Therefore, stable transport of the sheet S is realized, and this is advantageous in terms of recording images on the sheet S with high positional precision.

[0052] It is particularly preferable to use a constitution as noted above for a printer **1** for which UV ink that is cured by ultraviolet rays is ejected from the recording heads **51** and **52** on the sheet S, and the UV ink on the sheet S is cured using ultraviolet ray radiation. In other words, this kind of UV ink generates heat with the curing reaction, and also generates heat by the ultraviolet rays being absorbed. Therefore, on the sheet S, the temperature of the ink adhered parts is higher than the temperature of the other parts. Thus, there is a tension difference between the high temperature parts and the low temperature parts and the kind of tension distribution described above occurs on the sheet S, and fluctuation occurs easily for the sheet S between the platen drum **30** and the rear drive roller **32**. In light of that, using a constitution like that noted above, it is preferable to suppress tension fluctuation of the sheet S on the platen drum **30** regardless of the sheet S tension after separating from the platen drum **30**.

[0053] Also, with this embodiment, a tension sensor S**33** is provided on the driven roller **33** that winds the sheet S from the front drive roller **31** toward the platen drum **30**. A constitution that detects the tension of the sheet S using the tension sensor S**33** provided on the driven roller **33** in this way is able to detect the tension of the sheet S while suppressing the effect on the transport of the sheet S by the tension detection operation, which is preferable.

[0054] Also, with this embodiment, the sheet S is supported on the platen drum on which the sheet S is wound, and that receives the frictional force with the transported sheet S and rotates. With this kind of constitution, the platen drum **30** that supports the sheet S rotates following the transported sheet S. Therefore, the occurrence of slipping between the sheet S and the platen drum **30** is suppressed, and this is advantageous for stabilizing tension of the sheet S.

Other

[0055] As described above, with the embodiments noted above, the printer **1** correlates to the "image recording device" of the invention, the sheet S correlates to the "recording medium" of the invention, the ink correlates to the "liquid" of the invention, the front drive roller **31** correlates to the "first drive roller" of the invention, the rear drive roller **32** correlates to the "second drive roller" of the invention, the front drive roller **31** and the rear drive roller **32** working jointly function as the "transport unit" of the invention, the platen drum **30** correlates to the "support member" of the invention, the tension sensor S**33** correlates to the "detection unit" of the invention, and the printer control unit **200** correlates to the "control unit" of the invention. Also, with the embodiments noted above, the UV ink correlates to the "photo curing ink" of the invention, the UV lamps **61**, **62**, and **63** correlate to the "light irradiating unit" of the invention, the driven roller **33** correlates to the "driven roller" of the invention, and the platen drum **30** correlates to the "drum" of the invention.

[0056] The invention is not limited to the embodiments noted above, but can also have various modifications added to the item described above as long as it does not stray from the gist. For example, with the embodiments noted above, we described a case of applying the invention to a printer **1** using UV ink. However, the invention can also be applied to a printer **1** that uses another ink such as water based ink, for example.

[0057] In particular, it is preferable to constitute as shown in the embodiments noted above for a constitution for which water based ink on the sheet S is dried by warming the sheet S using an infrared heater. In other words, with this kind of constitution, when warming the sheet S with an infrared heater, a temperature difference occurs between the parts at which the water based ink is adhered and the other parts. Thus, there is a difference in the tension of the high temperature parts and the low temperature parts, and tension distribution of the sheet S occurs, so tension fluctuation of the sheet S occurs easily from the platen drum **30** to the rear drive roller **32**. In light of this, it is preferable to use a constitution like that of the embodiments noted above to suitably suppress tension fluctuation of the sheet S regardless of the tension of the sheet S after separating from the platen drum **30**.

[0058] Also, with the embodiments noted above, a tension sensor that detects the tension of the sheet S is provided on the driven roller **33**. However, the position at which the tension sensor is provided is not limited to this. In light of that, it is also possible to provide a tension sensor S**34** at the driven roller **34**, and to control the torque of the front drive motor M**31** based on the detection results of the tension of the sheet S moving from the platen drum **30** toward the rear drive roller **32** by this tension sensor S**34**, and to adjust the process tension Tb of the sheet S.

[0059] With the embodiments noted above, the transparent ink recording head **52** and the UV lamp **63** were provided. However, the invention can also be applied to the printer **1** that is not equipped with these.

[0060] Also, with the embodiments noted above, preliminary curing UV lamps **61** were provided, but it is also possible to constitute the printer **1** without these.

[0061] It is also possible to suitably modify the positions for arranging the recording heads **51** and **52** and the UV lamps **61**, **62**, and **63**.

[0062] Also, with the embodiments noted above, we explained a case when the invention was applied to a printer **1** which forms color images. However, it is also possible to apply the invention to a printer **1** that forms monochromatic images.

[0063] Also, with the embodiments noted above, the sheet S was supported on the round cylindrical shaped platen drum **30**. However, the specific constitution for supporting the sheet S is not limited to the platen drum **30**.

What is claimed is:

1. An image recording device comprising:

a transport unit that, by rotating a first drive roller and a second drive roller across which a recording medium is stretched, transports the recording medium from the first drive roller to the second drive roller,

a support member that supports the recording medium between the first drive roller and the second drive roller,

a recording unit that ejects a liquid on a recording medium supported on the support member and records an image,

a detection unit that detects tension of the recording medium, and

a control unit that gives tension to the recording medium by controlling the torque of the first drive roller based on the tension of the recording medium detected by the detection unit.

2. An image recording device according to claim **1**, wherein the control unit controls the speed of the second drive roller and rotates the second drive roller at a designated speed.

3. An image recording device according to claim **2**, further comprising

a take up roller that takes up the recording medium fed from the second drive roller,

wherein the control unit reduces the tension of the recording medium when taken up on the take up roller in accordance with an increase in the volume of the recording medium taken up on the take up roller by controlling the torque of the take up roller.

4. An image recording device according to claim **1**, wherein the detection unit detects the tension of the recording medium between the first drive roller and the support member.

5. An image recording device according to claim **4**, wherein the recording unit ejects as a liquid a photo curing ink that is cured by light, and

wherein the image recording device further comprises a light radiating unit that radiates light on the ink ejected from the recording unit onto the recording medium.

6. An image recording device according to claim **4**, further comprising

a driven roller that winds the recording medium from the first drive roller toward the support member,

wherein the detection unit is provided on the driven roller.

7. An image recording device according to claim **1**, wherein

the support member is a drum on which the recording medium is wound, and rotates by receiving a frictional force with the recording medium transported by the transport unit.

8. An image recording method that, by rotating the first drive roller and the second drive roller across which a recording medium is stretched, supports on a support member the recording medium transported from the first drive roller to the second drive roller, and also ejects liquid on the recording medium supported on the support member to record an image,

wherein tension is given to the recording medium by controlling the torque of the first drive roller based on the tension detection results of the recording medium.

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